Mesonet observations of wake lows and heat bursts across northwest Texas

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The heat burst is characterized near ground level by a rapid increase in temperature, decrease in dewpoint, falling pressure, and the onset of high winds. Previous studies have established two moist convective processes that may initiate heat bursts. The first is akin to the thunderstorm downburst or microburst. In this case, the heat burst is formed when the evaporation or sublimation of hydrometeors in a thunderstorm downdraft creates a negatively buoyant air parcel, whose downward momentum is sufficient to penetrate a stable surface layer (the most pronounced heat bursts occur in the presence of a nocturnal or outflow generated inversion). Parcel descent is aided by a dry subcloud layer where evaporative cooling is inadequate to maintain saturation or offset adiabatic warming and the parcel continues to the surface despite being warmer than its environment. The second case is the result of the development of a wake low in the trailing stratiform precipitation region of a mesoscale convective system. Wake lows are thought to be generated by subsidence warming brought about by a rapidly descending rear-inflow jet. In this case, a heat burst may be associated with an enhancement of this descending jet by downdrafts of individual decaying convective cells.

The thermodynamic environment that supports wake lows and heat burst development is most commonly observed in the high plains during the warm season. While documented heat bursts are infrequent due at least in part to the sparsely populated nature of this region, the recent expansion of surface mesonetworks are increasing the likelihood that these events will be sampled. Various stations of the **West Texas Mesonet**, a collection of over forty meteorological stations spread across the Panhandle and South Plains of northwest Texas, have sampled over a dozen wake low/heat burst events during the period 1 June 2004 to 30 June 2006. These stations measure meteorological variables at five-minute intervals (including peak two-second wind gusts). Some of the more extreme measurements include a 15 degree C increase in temperature at Pampa and McClean during one event, and 35 m s^{-1} wind gusts at sites in Brownfield and Jayton on separate occasions. Additionally, several of the events have caused considerable property damage, including one which impacted the city of Lubbock on 17 September 2005. Thus, these phenomena represent a significant threat to lives and property and are of interest to the forecast community.

This paper will survey the mesoscale environment of the wake lows/heat bursts through analyses of the West Texas Mesonet stations augmented by supporting radar, satellite and profiler data. It is hoped this information will prove useful to forecasters to predict the onset and evolution of heat bursts.